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INSTRUCTIONAL-CUM-PRACTICAL MANUAL
ON
BASIC MATERIALS AND RELATED WORKSHOP
FOR
LINEMAN VOCATION CLASS - XI

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(33)

CONTENTS

TITLE OF EXPERIMENT/PRACTICAL	PAGE No.
Simple peactice in cutting of metal pieces by hand hacksaw to cut to given different dimensions - conduit-pipe, G.I. pipe, M.S. Rod, M.S. flat, angle iron, stranded G.I. wire and M.S. Sheet.	1
Bending of Aluminium (AL) and Mild steel (M.S.) strips, Making of rectangular and round bend.	4
Bending of stranded Aluminium (AL), copper (CU) and Galvanised iron (G.I.) Wires:- Preparing eye-let from stranded wire	8
To Compare the relative Strength of copper (CU), Aluminium (AL) and G.I. Wire by elongation test.	10
Practice in filing-making of Square/ Rectangular piece from M.S. Flat.	13
Practice of grinding - grinding of Chisels and screw drivers.	16
Practice in drilling:- Earth plates, clamps, M.S. and Al Strips and Bakelite sheets	18
Practice in chipping of mild steel and cast iron blocks.	20
Practice in Internal and External thread cutting in conduits, rods and plates. Making conduit joints, earth plates, stay rods and cross - arms.	23
Practice in Wooden sawing, planning and chiseling-making cross halving joint and Sawing of Sun-mica and Bakelite sheets.	27
Scrapping - sandung, priming and painting of metal poles and their fittings.	32
Treatment and painting of Wooden poles.	34
- Appendix I: List of Contributors.	36
- Appendix II: Review and Editing Committee.	37
- Appendix III: Questionnaries for collecting opinion of Teachers and Students.	38

PREFACE

Ever since the introduction of Vocational Education in our school system by several States and Union Territories in our country, the paucity of appropriate instructional materials has been felt as one of the major constraints in implementation of the programme and a source of great hardship to pupils offering Vocational Studies at the higher secondary stage.

Deptt. of Vocationalization of Education (DVE) of the National Council of Educational Research and Training (NCERT), New Delhi has started a modest programme of developing instructional materials of diverse types to fill up this void in all major areas of Vocational Education. The task is too gigantic to be completed by any single agency but the model materials being developed by us might provide guidance and impetus to the authors and agencies desiring to contribute in this area. These are based on the national guidlines developed by a Working Group of experts constituted by NCERT. The present Manual is on BASIC MATERIALS AND RELATED WORKSHOP for Lineman Vocation Class XI. It contains practical exercises to be performed by the students with simple steps to follow, precautions to be taken and data to be observed and recorded in observation sheet. Each experiment is complete with specific objectives, theoratical information, behavioural outcome and questions for evaluation, etc. It is hoped that the students will find them immensely useful.

The pages that follow contain a draft of the manual which will be finalised after obtaining the feedback from the students, teachers and others concerned. The materials will then be published in printed form.

The users are requested to complete the questionnaire appended and return the same to us. Comments and suggestions for improvement of the material are cordially invited.

The material has been developed by a group of experts as authors in a Workshop held at the Technical Teachers' Training Institute, Chandigarh from 1 to 8 December 1983. Their names are mentioned elsewhere and their contributions are admirably acknowledged. This material was edited and finalised by another group of experts at our Deptt from 30 January to 2 February 1984. Our thanks are also due to the experts for taking pain to veryfying the authenticity of contents of the Manual. Shri Sachchidananda Ray, Lecturer in Technology deserves special thanks for editing and bringing the material in the present form. The assistance rendered by the staff members of CDC, TTTI, Chandigarh and D.V.E., NCERT for bringing out this manual is also thankfully acknowledged.

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INTRODUCTION

The Vocationalization of higher secondary education in the 10+2 pattern of schooling has been introduced by several States and Union Territories in the country. The implementation of this programme received further encouragement by the conference of Education Ministers in 1981. With the priorities laid down in the Sixth plan a few more states are seriously planning to switch over to 10+2+3 pattern of education and to implement Vocationalization at the plus two stage.

The implementation of the programme for the states and Union Territories has revealed that there is a great dearth of appropriate instructional materials. Since the vocational Courses laid a great emphasis on practical training it has become necessary to prepare Instructional-cum-Practical Manuals best suited for these courses. The absence of appropriate instructional materials has been one of the major constraints in the implementation of the programme and a source of great hardship to students offering vocational studies at the plus two stage.

To develop models of instructional materials, the Unit constituted a Working Group to formulate guidelines for the development of instructional materials and to prepare brief ex-emplar units. National guidelines were developed by this Working Group for preparation of instructional material.

The manual on Basic Materials and Related Workshop for Lineman Vocation class XI has been developed based on the guidelines recommended by Working Group. This manual is envisaged to help both teachers and students. Each experiment is complete with specific objective, introductory information and related theory, equipment and materials, diagram, procedure, record of observation, precaution and questions for evaluation. In order to acquaint the students about each experiment, the teacher should provide them with required theoretical knowledge or information related to the experiment. This will help the students for proper understanding of the experiment and enable them to perform the experiment properly and effectively.

In order to meet the stipulated objectives, the experiments include the study and operation of tools and instruments which a lineman would be required to use in his professional career, operation of machines, visit and study of Sub-Station, Power-Station and Factory. It is believed that the time spent in the laboratory and the field study will help the students to acquire sufficient confidence to handle his job with deligence.

The evaluation of the experiments performed by the students shall be based on the specific objectives. The teacher shall evaluate all the aspects which are relevant to achieve the specific objectives. This will contribute towards the "expected behavioural outcome." Evaluation is an important aspect of performing the experiments. Each experiment should be assessed through evaluation based on knowledge, acquired skills and competencies, attitude and aptitude towards work, experiment performance, application, maintenance of experiment record. Tabular representation of suggested evaluation scheme is given below:

Sl. No.	Components	Marks allotted	Marks obtained
1.	Knowledge	20	
2.	Acquired skills and competencies	35	
3.	Attitude and Aptitude towards work	15	
4.	Experiment performance	10	
5.	Application	10	
6.	Maintenance of Experiment Record	10	
	TOTAL MARKS	100	

At the end of each experiment, some questions for evaluation are given. The students shall answer these questions after the completion of each experiment and teacher shall examine them. If required, necessary corrections and suitable suggestions should be incorporated by the teacher. However, the answer to these questions should not be considered for the purpose of awarding final grade or marks.

EXPERIMENT/PRACTICAL No.1

TITLE OF EXPERIMENT/PRACTICAL :-

Simple practice in cutting of metal pieces by hand Hacksaw to cut to given different dimensions - conduit pipe, G.I. pipe, M.S. Road, M.S. Flat, Angle Iron, Stranded (GI) 'wire' and M.S. Sheet.

SPECIFIC OBJECTIVE :-

To acquire skill in the correct use of hand hacksaw for metal cutting/sawing.

INTRODUCTORY INFORMATION AND RELATED THEORY :-

INFORMATION :- A lineman is required to cut various metal pieces like conduit pipe, Mild steel rod, M.S. flat, Angle Iron, Stranded wire etc. in day to day use. So he must know the correct use of hacksaw. The instructor should show to the students all the above metal pieces and also tell about their use.

RELATED THEORY:-

Hand Hacksaw is required to cut metal pieces. It consists of two type of frames - (1) Solid frames and (2) Adjustable frames. Commonly used hacksaw blades are of 250 mm and 300 mm. length. Coarse teeth saw has 14 to 16 teeth per 25 mm. and fine teeth saw has 20 to 30 teeth per 25 mm.

Generally soft metals and copper alloys are cut by coarse teeth saw and materials of small thickness such as tubes are cut by fine teeth saw.

EQUIPMENT AND MATERIAL :-

EQUIPMENT :-

1. Bench vice of 150 mm jaw opening.
2. Pipe vice (for holding the pipe).
3. Adjustable hand saw.
4. Hacksaw blades coarse and fine teeth.
5. Steel scale 300 mm. length.
6. Scriber
7. Smooth file 300 mm. length.
8. Triangular file 150 mm. length.

MATERIAL :-

Different types of materials such as conduit pipe, G.I. Pipe, Angle iron, M.S. flat, M.S. Rod, stranded wire of 300 mm length each.

PROCEDURE :-

(a) CUTTING OF PIECES :-

1. Select the fine teeth blade and fix it in the adjustable hand hacksaw frame. Blade should not be too tight or too slack. Make sure that teeth of hacksaw blade are in the forward direction (away from the handle).
2. Now mark the point on the given length of pipe with the help of scale and scriber at a distance of 50 mm.
3. Hold the pipe firmly in pipe vice so that pipe is approximately 100 mm. outside the vice to avoid vibration.
4. At the marked point make a notch with the help of triangular file.
5. Now place the hand hacksaw blade on the notch. Start sawing with a backward stroke and apply pressure during the forward stroke only with a spped of 45 to 55 strokes per minute (Forward and return)

   Turn the pipe forwardly occasionally to such an extent that saw will be guided by the slot already cut. Then continue sawing and cut to a point shortly before the inner wall of the pipe. Make the last and final cut, holding the stock to be cutt of in one hand and operating the saw with the other hand.
6. Remove the burrs with flat smooth file.

(b) CUTTING OF M.S. FLAT/ANGLE IRON/M.S. ROD/STRANDED WIRE ETC.

1. For cutting the M.S. flate/Angle iron, the jobs should be hold in a bench vice and M.S. rods/ stranded wires are to be hold in a pipe vice. The remaining procedure of cutting is the same as for pipe cutting except that no turning of job is required in the case of M.S. flat/ Angle iron.

PRECAUTIONS:-

1. Hold the job firmly in the vice to avoid breaking of the blades.
2. The job should not project too much out of the vice.
3. Do not twist the hacksaw otherwise the blade will break.
4. Blade should not be too tight or too slack.
5. Do not apply much pressure while sawing.

QUESTIONS FOR EVALUATION :-

1. What are the different types of Hand Hacksaw frames?
2. What types of blades will be used for (a) cutting soft-metals and (b) for cutting hard metals?
3. What should be the direction of the teeth of the blade while fixing in frame?
4. Does a saw blade cut on the return stroke of saw?
5. What should be the spped of cutting by hand hacksaw?
6. What are the causes of breaking of hacksaw blades?
7. What is the use of triangular file?
8. What is the use of smooth file?
9. Why the job should not project too much outside the vice?
10. What should be the speed of hacksaw?
11. What is the result of sawing too fast?

EXPERIMENT/PRACTICAL No. 2

TITLE OF THE EXPERIMENT/PRACTICAL :-

Bending of aluminium (Al) and mild steel (M.S.) strips - making of rectangular and round bend

SPECIFIC OBJECTIVES :-

1. To develop skills in bending metal strips of aluminium and M.S. steel.
2. To be able to list the properties of Al, M.S.

INTRODUCTORY INFORMATION AND RELATED THEORY :-

INFORMATION :- The above practical will be useful to the lineman in his day-to-day work like bending of Al, and M.S. strips for jobs like earthing strips, clamps etc. The instructor should show to the students some applications of bends.

RELATED THEORY :-

Before any metal strip is bent we should know about its properties like hardness, ductility, malleability and brittleness.

HARDNESS :-

A metal is hard which has resistance to abrasion. It means that a metal which is hard will have difficulty in bending and will have a tendency to break at the bending point.

DUCTILITY :-

It is the property which enables a metal to be drawn out without rupture. It means that the metal which is ductile is soft and can be easily bent to any shape

MALLEABILITY :-

It is the property which enables a metal to be flattened into thin sheets.

BRITTLENESS :-

It is the property of breaking while bending. This means that a metal which is brittle cannot be bent at all. (The teacher should practically demonstrate the above 4 properties of metal).

EQUIPMENT AND MATERIALS :-

EQUIPMENT :-

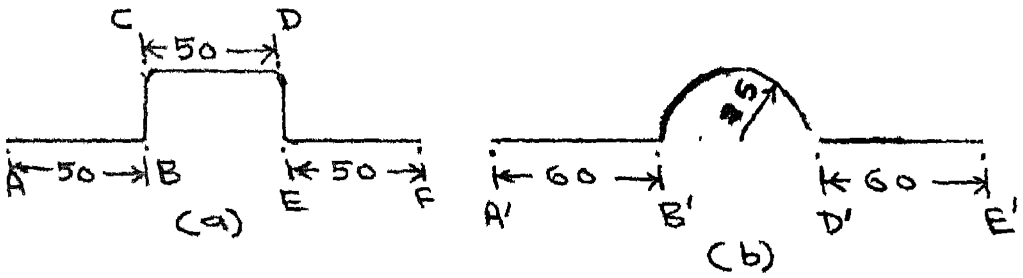
1. Ball peen hammer
2. Hand hacksaw
3. Anvil

4. Scale 150 mm or 300 mm. length
5. Strips or shears
6. M.S. rod of 25 or 50 mm dia
7. Try square
8. Soft metal vice clamps

MATERIAL:

Strips of Al and M.S. of size 200 mm X 25 mm X 3 mm

DIAGRAM:



(a) (b)

PROCEDURE:-

1. Mark with the help of scale and cut a strip of the size 200 X 25 X 3 mm from a given strip with hacksaw/strips/shears. Straighten the strip with hammer if required.

2. FOR SQUARE CLAMP:-

   Mark the dimentions on the strip with the help of scale as given in the diagram and mark points A, B, C, D, E and F. Add an amount equal to one half the thickness of the metal for each bend.

3. Hold the strip firmly in the bench vice at point C with extra allowance above the jaws. Check with try square that the piece is in vertical position.

4. Hold the upper end of strip in the left hand and bend the strip with hand and simultaneously hammer at the point C till the right angle bend is formed.

5. Remove this strip from the vice and with the help of Anvil make it a perfact right angle bend

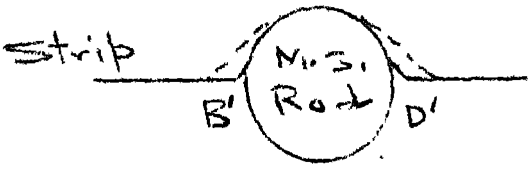
6. Check the correctness of bend for right angle with the help of try square.

7. Similarly make the bend at point D and then at points B and E.

8. Check the dimensions of the clamp and straighten the arms with the help of anvil and hammer, if required.

ROUND CLAMP:-

1. Follow the same procedure as explained in (1 and 2) for square clamp.
2. First make the bends at the points B and D adopting the procedure as for square clamp.
3. Hold the M.S. rod in the vice and keep the piece on this 25 mm dia. rod as shown in the diagram and hammer slowly at the points between B and D for forming the round bend. (The diameter of rod is equal to the diameter of inside of circle to be bent).



4. Check the diamensions and correct the straightness of arms with the help of hammer on the above.

Note: Bends of less than 90° can be made with a monkey wrench as shown in the figure.

PRECAUTIONS:-

1. While bending aluminium strip, use soft metal vice clamps to avoid sdamage.
2. Fix the strip tightly in the vice but use of hammer for tightening the vice is now allowed.
3. Before using the hammer, it must be ensured that handle is tightly fitted into the hammer.
4. Hold the hammer at the end of handle. It should not be held from the middle of handle.
5. Use hammer giving light blows.
6. Avoid sharp bends.
7. Check the metal piece with try square that it is in vertical position

QUESTIONS FOR EVALUATION :-

1. Why soft vice clamps are used for holding soft metal jobs in the vice?
2. Whether a bend can be made from cast iron (C.I) and stainless steel piece?

3. Why sharp bend should be avoided?

4. Why light blows are required for making a bend?

5. How will you differenciate between Al and M.S. strips with regard to colour and weight?

6. What should be the diameter of rod for making circular bend.

EXPERIMENT/PRACTICAL No.3

TITLE OF THE EXPERIMENT/PRACTICAL:-

Bending of stranded aluminium, copper, galvanised iron (Al, cu and G.I. wire): Preparing eye-let from stranded wire.

SPECIFIC OBJECTIVE:-

To acquire proper bending skill of wires.

INTRODUCTORY INFORMATION AND RELATED THEORY:-

INFORMATION:

The above practical will be useful to the lineman in his day-to-day work like bending copper, aluminium and galvanised iron wires (cu, AL and GI wire) for jobs like in earthing and stay wires and eyelet making.

RELATED THEORY:-

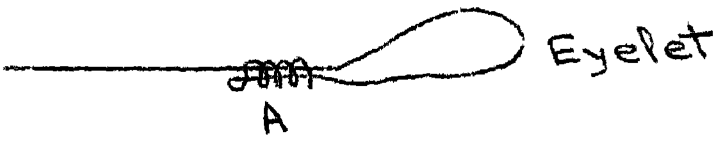
Before any wire is bent, we should know about the properties of the concerned metal like hardness, ductility, and brittleness as explained in practical No.2.

EQUIPMENT AND MATERIAL:-

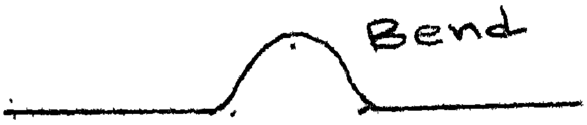
EQUIPMENT: 1. Hacksaw
2. Cutting plier.

MATERIAL:- 1. Scale of 150 mm. or 300 mm
2. Stranded wire of 7/18 of cu, AL and GI.
3. Binding wire 14 SWG . of cu, aluminium and GI wire 300 mm length

DIAGRAM:-



(a)



(b)

PROCEDURE:

1. Mark with the help of scale and cut the wire of 300 mm length from the given wire using hacksaw or plier as required.
2. Hold the wire in left hand and use the plier to bend the wire to the required shape. (Figures (a) and (b)
3. The radius of the bend should not be less than 8 times the diameter of the wire.
4. The end of the wire at the overlap joint should be sufficient in length.
5. At the point of the overlap, A use binding wire to strengthen the joint.

PRECAUTIONS:-

1. Make sure that the radius of the eyelet is not less than 8 times the diameter of the wire.
2. Bend the wire uniformly.
3. While overlapping, take care that the wire does not break and the overlapping wire is of sufficient in length.

QUESTIONS FOR EVALUATION:-

1. What do you understand by stranded wire?
2. What is the maximum size of solid wire which can be used for bending?
3. What is meaning of 14 S.W.G.?
4. What is meaning of 7/18 and 4 mm^2 (75) size of wire?
5. Why binding wire is required at the overlap point?
6. Why the radius of bend should not be less than 8 times the diameter of the wire?

EXPERIMENT/PRACTICAL No.4

TITLE OF THE EXPERIMENT/PRACTICAL:

To compare the relative strength of Copper (Cu) Aluminium (Al). and G.I. wire by elongation test.

SPECIFIC OBJECTIVES :-

Able to compare the relative strength of Al, cu, and G.I. wires.

INTRODUCTORY INFORMATION AND RELATED THEORY:

INFORMATION :-

Lineman will be required to use Al, cu, and G.I. wires in day to-day work like in service line, overhead line and guard wire.

RELATED THEORY:-

Before a wire of a particular material is to be used for a specific purpose, he should know, which metal has more strength and accordingly he should be able to select proper material for a specific purpose. G.I. wire has more strength than aluminium wire.

Tensile strength of copper is 4900 KG/cm^2 of aluminium is 1700 1700 KG/cm^2 and G.I. wire is 5300 KG/cm^2

EQUIPMENT AND MATERIALS :-

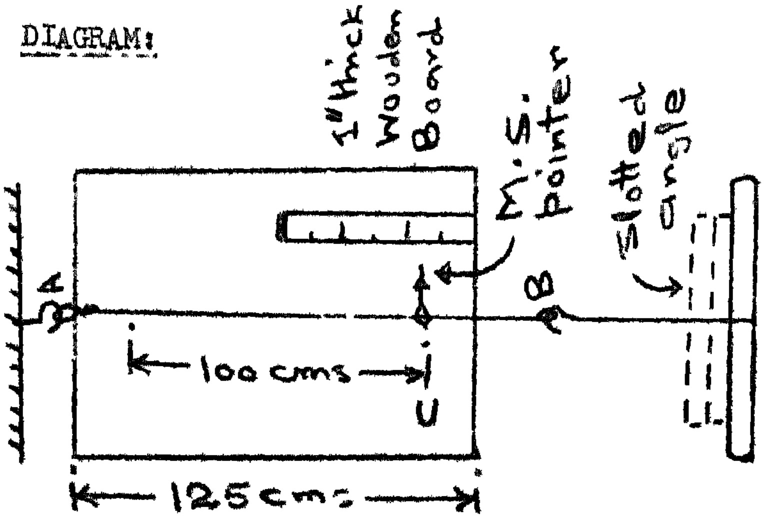
EQUIPMENTS:-

1. Slotted weights with weight hanger 21 Kg.
   - 1 Kg. X 15 = 15 Kg
   - ½ Kg. X 10 = 5 Kg.
   - 50 Gm X 20 = 1 Kg.
2. Wooden board of the size 125 cms X 15 cm X 1 cm of teak wood with a scale fixed on the board with mm graduations.
3. M.S. pointer.

MATERIAL:-

Wires of Al, cu and G.I. of 1 met. length, gauge 1/22.

DIAGRAM:



PROCEDURE:-

1. Take wire of Al. of length 175 cm of 1/22.
2. Make sure that there are no kinks in the wire.
3. Form eyelets at both ends of the wire.
4. Hang the wire on to the fixed hook A.
5. Attach the weight hanger at the other end of the wire
6. Fix M.S. pointer at distance of 100 cm from A at the point C.
7. Note the initial reading.
8. Add weights in steps till you notice movement of the pointer and record the reading in tabular form.
9. Add further weights in steps, till it breaks and note the weight.
10. Repeat the experiment with cu and G.I. wires of the same dimentions

TABLE RECORD OF OBSERVATIONS

Record the reading in the following format:

WEIGHT	ELONGATION IN mm.		
	Al.	Cu.	G.I.
W_1			
W_2			
W_3			
W_4			
W_5			

CONCLUSION:

From the above observations compare the relative strengths of Al, cu, and G.I.

PRECAUTIONS:-

1. Eyelets at both ends should be strong enough to take the load.
2. There should not be any kink in the wire.
3. Pointer should be rigidly fixed to the wire.
4. Weights should be added in steps.
5. Be cautious when you approach the breaking point, from the falling weight and the wire springing up at the breaking point.

F-16c68
2S1Xt.

QUESTION FOR EVALUATION :-

1. What is the purpose of performing this experiment?
2. Which material wire, you will select for the following spans?
   - i) span of 15 metres
   - ii) span of 25 metres
   - iii) span of 50 metres
3. Why GI wire is used for guard wire in overhead lines?

EXPERIMENT/PRACTICAL No.5 .

TITLE OF THE EXPERIMENT/PRACTICAL :-

Practice in filing - making of square piece/rectangular piece from M.S. Flat.

SPECIFIC OBJECTIVE :

1. To develop correct skill in filing.
2. To make the items of required diamensions by filing.

INTRODUCTORY INFORMATION AND RELATED THEORY :

INFORMATION:-

Filing is the important operation and a lineman should acquire this skill, because he may be required to use the file for finishing various fitting.

RELATED THEORY:-

Filing is an after treatment and usually done after chipping. It serves to remove the burrs from cuts and clean the face of the cuts and to give final finish to the workpiece. By filing, work can be finished to an accuracy of 0.05 mm. and even to 0.07 mm. Normally the work is held in a vice and work should be in level of student's elbow. The file is worked paralled to the plane of the work. Draw Filing is done to produce smoother surface and greater accuracy. Diagrams of cross . Filing and draw filing are shown. Files are available in various shapes such as Flat, square round, half round and triangular etc. The shape of file is generally governed by the work in hand.

EQUIPMENT AND MATERIAL :-

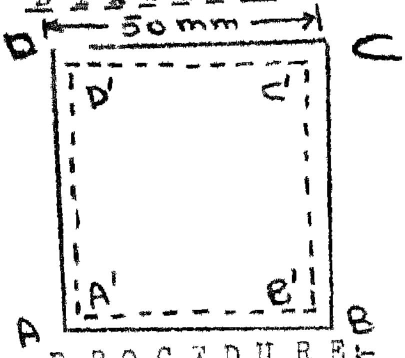
EQUIPMENT:-

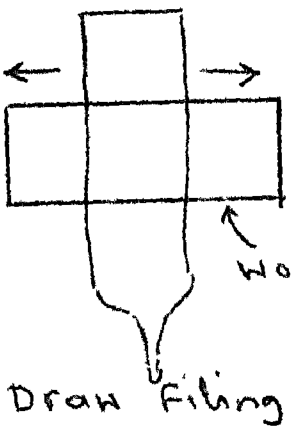
1. Bench vice of 150 mm. jaw opening
2. Different types of files flat, second cut and smooth
3. Try square,
4. Punch,
5. Scriber,
6. Surface plate,
7. Scale of 300 mm.
8. Hammer,
9. File cleaning brush (Stiff Steel wire brush)
10. A piece of chalk.

MATERIAL:-

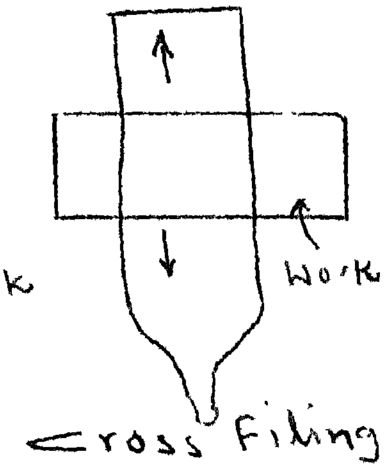
M.S. Square piece of 51 X 51 X 10 mm. and rectangle piece of size 76 X 51 X 10.

DIAGRAM:-





Draw Filing



Cross Filing

PROCEDURE:-

(a) For square piece:

1. Wet the given piece of M.S. flat ABCD with water and apply chalk on the one flat side of piece.
2. Place the piece on surface plate and mark the given diamentions with the help of scale, try square, scriber and mark the lines.
3. Punch the marked lines at short distances with the help of punch and light stroke of hammer (A' B' C' D').
4. Hold the piece in the bench vice in such a way that marked line is just above the vice jaws.
5. First use the bastard file (Rough cut) to remove the extra material in the following manner:
    (a) Make sure that the job is in level with the elbow.
    (b) Place the left foot in the direction of the file stroke and right foot at right angle to left foot.
    (c) Grip the file handle with right hand to guide the file and while working with the file, left thumb should be placed on the end of the file blade and fingers should curl under it for light filing and the palm of left hand for heavy filing
    (d) Now make the file stroke forward with even pressure.
    (e) Downward pressure should be released during the return stroke.

Now use the smooth file for finishing the job to the required dimension adopting the same filing procedure as explained above for the bastard file.

6. Remove the job from vice and prepare the other side in the same way.

   (b) For rectangular piece:

   Adopt the same procedure as for the square piece.

PRECAUTIONS:-

1. Do not use hammer for tightening the job in bench vice.
2. Do not rub the hand over the finished surface.
3. Use soft material between finished surface of work and hardened jaws of vice.
4. Never use a file without handle and make sure that handle is firmly attached to the file.
5. Do not use clogged file. It must be cleaned by cleaning brush before use.

QUESTIONS FOR EVALUATION:-

1. What are the different types of files. Explain when they are used.
2. What is the proper way to hold a file?
3. What should be the position of body while filing?
4. Why a file should not be used without a handle?
5. Why the hands should not be rubbed over finished surface?
6. What is the meaning of clogged file ?
7. Why the file should be moved paralled to the plane of the work?

EXPERIMENT/PRACTICAL No. 6

TITLE OF THE EXPERIMENT/PRACTICAL :-

Practice of grinding - grinding of chisels, and screw drivers.

SPECIFIC OBJECTIVE :-

To develop skill in grinding.

INTRODUCTORY INFORMATION AND RELATED THEORY :-

INFORMATION:-

Grinding operation is required in day-to-day work for dressing, shaping or finishing surfaces. In workshop it is generally used for sharpening cutting tools.

THEORY:-

The grinding operation comprises the application of a wheel of a abrasive character rotating at high speed. The grinding wheel is embedded with small abrasive particles, which act as multipoint cutting tool. When the grinding wheel rotating at high speed, comes in contact with the job, it removes material in the form of very fine particles

TRUING AND DRESSING OF WHEELS :-

For best operating conditions a grinding wheel should run perfectly true and have straight faces. Wheel is dressed by "DRESSER".

EQUIPMENT AND MATERIAL :-

EQUIPMENT:-

1. Double ended bench grinder with coarse and fine wheel of 175 mm diameter.
2. Safety goggles
3. Small can for water.

MATERIAL:-

1. Blunt cutting tools
2. Screw drivers
3. Drill bits
4. Chisels
5. Broken or unserviceable hacksaw blade

PROCEDURE:-

1. Wear safety goggles.
2. Start the grinding machine.
3. First grind the cutting tool to the required angles making use of the coarse grinding wheel.

4. Cutting tool tip is to be dipped in water, whenever it gets hot.

5. For giving a final finish, use the fine grinding wheel.

6. If the material to be removed is not more, than 0.1 mm., use fine wheel.

PRECAUTIONS:-

1. Before using the grinder, make sure that Protective guards are fitted.

2. Always use goggles while working on grinder.

3. Check the wheel for its soundness by tapping the wheel lightly. A clear ringing will be heared if the wheel is sound.

4. Do not grind very small jobs which cannot be held rigidly.

5. Do not press the job too much against the grinding wheel.

6. Do not wear, loose dress, while grinding.

7. Never use the side of wheel for grinding.

8. Do not hold the metal on the wheel for long as it will burn.

QUESTIONS FOR EVALUATION:-

1. Why wheel guards are to be fittled to the grinder?

2. Why the job should be dipped in water?

3. Why the wheel has to be treated for the soundness before grinding?

EXPERIMENT/PRACTICAL No.7

TITLE OF THE EXPERIMENT/PRACTICAL :-

Practice in Drilling - earth plates, clamps, M.S. and Aluminium strips and bakelite sheets.

SPECIFIC OBJECTIVES :-

To develop skill in Drilling.

INTRODUCTORY INFORMATION AND RELATED THEORY :-

INFORMATION:-

Drilling operation is required for making holes in the material. Holes have to be drilled in jobs like earth plates, clamps M.S. sheets and bakelite sheets.

RELATED THEORY :-

The most common tool for making holes is the twist drill. It consists of a cylindrical piece of steel with spiral grooves, one end of which is pointed, the other end is shaped so that it may be attached to a portable or stationary drilling machine. The material is removed by rotating twist drill bit. Ordinary standard twist drill can be used for brass. For Aluminium and copper, special drill with quick spiral is used. Use fast speeds for small size drill and soft material but for large drills and hard materials use slow speed.

EQUIPMENT AND MATERIAL :

EQUIPMENT:-

1. Bench drilling machine with vice
2. Portable electric drilling machine
3. Hand drilling machine
4. Set of drill bits
5. Chalk
6. Centre punch
7. Hammer
8. Scriber

MATERIAL:-

1. M.S. Strip
2. Aluminium strip
3. Bakelite sheet

PROCEDURE:-

1. Apply chalk with water on the surface of the job.
2. Mark the centre point of the hole with help of scriber and scale.
3. At the centre point, make a punch mark with a centre punch and a hammer, to provide a seat for the drill.
4. Hold the plate firmly in the machine vice.
5. Fit the drill bit of required size in the drill chuck.
6. Start the machine and lower the drill bit on the punch mark.
7. Apply pressure gradually and feed the tool into the job and drill the hole (note: in case of drilling material of thickness 10 mm. and above, use appropriate lubricant).

PRECAUTIONS:-

1. Job should be firmly fixed in the vice.
2. Drill bit should be tightly fixed in the chuck.
3. Never use a blunt or dull drill.
4. Gradual pressure to be applied on the hand lever.
5. Do not wear loose dress.
6. If the job gets heated during drilling operation, appropriate lubricant is to be used as per the material.
7. Do not hold the job in your hand while drilling.

QUESTIONS FOR EVALUATION :-

1. What is a drill ?
2. What are the types of drilling Machines ?
3. Why job should not be held by hand, while drilling ?
4. What is a dull drill ?
5. What should be the speed of drilling soft material ?
6. What should be the speed for drilling hard materials ?

EXPERIMENT/PRACTICAL No.8:

TITLE OF EXPERIMENT/PRACTICAL:

Practice in chipping of Mild steel and cast iron blocks.

SPECIFIC OBJECTIVE:-

To develop skills in chipping.

INTRODUCTORY INFORMATION AND RELATED THEORY:

1. INFORMATION:-

A line-man may be required, in his day to day work to do chipping on M.S. or cast iron items. So it is necessary for the lineman to know the skill of chipping.

2. RELATED THEORY:-

Chipping is the method to remove thick layers of metal with the help of hammer and cold chisel. The cold chisels are generally made of carbon steel and the cutting edge is tempered. Chisels are available in rectangular, hexagonal or Octagonal cross-section. The most commonly used chisels are Flat, Cross cut, diamond point and Round nose. For effective cutting, the cutting angle of the chisel is important. The cutting angle is different for different materials. The following cutting angles are suitable for different materials.

Cast iron	60°	to	70°
Mild steel	50	to	65
Brass	50	to	65
Copper	45	to	50
Aluminium	30	--	35

The chisels are forged to shape, roughly ground, then hardened and tempered. Cross cut chisel is used for taking deeper and heavier cuts. The diamond point is used for finishing work and for cutting oil grooves.

Hammers are made of forged steel of various sizes and shaps to suit various purposes. They are available from 0.11 Kg. to 0.33 Kg. for light work, 0.45 Kg. for chiselling, and 0.91 Kg. for chipping work.

EQUIPMENT AND MATERIAL:

EQUIPMENT:-

1. Bench vice 150 mm. jaw opening.
2. Cold chisel - flat.
3. Hammer - 0.91 Kg.
4. Safety goggles.
5. Scriber.
6. Chalk
7. Centre punch
8. Chipping ground

MATERIAL:-

Cast iron piece 100 X 20 X 20 mm.

M.S. piece 100 X 20 X 10 mm

PROCEDURE:-

1. Smear wet chalk on the faces of the given C.I. piece.
2. Mark a line from the top of the piece at a distance of 2 mm. on opposite faces.
3. Make centre punch marks on the line at equal intervals of 2 mm. distance.
4. Fix the job with bench vice, lengthwise. In case there is gap between the lower piece of the job and surface of the lower fixed jaw, fix a wooden piece to support the job, firmly.
5. Wear the safety goggles
6. Hold the handle of the hammer in the right hand at the extreme end of the handle.
7. Hold the chisel firmly in the left hand about 25 mm. below the head of the chisel.
8. Hold the cutting edge of the chisel on the point where the cut is desired at about 70° angle, that will cause the cutting edge to follow the desired surfaces.
9. Now strike the chisel head with the hammer with heavy blows. Take care not to injure the hand.
10. After each blow of the hammer the chisel should moved up against the work, otherwise much of the force of the blow is wasted.

11. Continue chipping till the material is removed upto the marked line.
12. Adopt the same procedure for M.S. block.
13. During chipping, if the cutting edge chips or cracks or it quickly becomes dull and rounded, this means the chisel needs re-tempering.

PRECAUTIONS:-

1. The job should be firmly held in the vice with proper wooden support at the botton.
2. Do not use blunt chisel.
3. Hammer head should be firmly fixed in the handle.
4. Hammer should alway be gripped at the extreme end of the handle.
5. Chisel should be held 25 mm. below the head of the chisel and should be at an angle of 70 degree to the job.
6. Goggles must be used while chipping.
7. Use chipping guard when others are working at the same table.
8. Be careful while hammering.
9. While chipping, eyes must be kept on the cutting edge of the tool and not on its hand.

QUESTIONS FOR EVALUATION:

1. What is the purpose of chipping?
2. What is the purpose of using safety goggles?
3. What is chipping guard?
4. Why the chisel is held at 70 degree while cutting?
5. Why wooden packings are placed below the job?
6. At what point the chisel should be gripped?
7. Why the hammer is held at the extreme end of the handle?
8. Why the chisel should be moved after each blow of the hammer?
9. What are different types of chisels?
10. Where do we use diamond point chisel?

EXPERIMENT/PRACTICAL No.9

TITLE OF EXPERIMENT/PRACTICAL:-

Practice in Internal and External thread cutting in conduits, rods and plates. Making conduit joints, earch plates, stay rods and cross arms.

SPECIFIC OBJECTIVES:-

1. To develop skills in internal thread cutting by taps.

2. To develope skills in external thread cutting by Dies.

INTRODUCTORY INFORMATION AND RELATED THEORY:-

INFORMATION:-

Line-man is required in his day to day work to cut internal and external threads on jobs like conduit pipes, rods and in holes of earth plates.

RELATED THEORY:-

Threads can be produce either by hand with the help of taps and dies or on lathes with specially shaped cutting tools. But lineman will be required to use only taps and dies to produce internal and external threads.

TAPS

It is a screw like tool which has threads like a bolt and three or four flutes cut across the threads. It is used to cut internal threads. The tap set consists of three taps:

(i) Tapered tap (Rougher)

(ii) tap (Intermediate or plug tap.

(iii) Bottoming tap (Finishing tap).

DIES:-

It is a round or square block of hardened steel with a hole containing threads and flutes which form cutting edges. The dies are of two types (i) Solid die (ii) Adjustable die. It is used to produce external threads on round metal objects such as conduit-pipes and rods.

EQUIPMENT AND MATERIAL:-

EQUIPMENT:-

1. A set of taps of different sizes
2. Large and smaller tap wrenches .
3. Bench vice of 150 mm. jaw opening
4. Lubricating oil
5. Adjustable die
6. Die stock
7. Bench pipe vice
8. Bastard file.

MATERIALS:-

1. M.S. flat of size 100mm X 100mm X 10mm with already drilled whole of not less than 3 mm diameter.
2. Conduit pipe of 300 mm X 12 mm
3. M.S. Rod of 300 mm X 10 mm.

PROCEDURE:

(a) INTERNAL THREAD CUTTING:-

1. Hold the M.S. flat firmly in the vice
2. Fix the taper tap in the wrench.
3. Hold the tap with right hand directly over the tap then place the tap in the whole making sure that it is held at right angle to the work piece.
4. To start the thread apply downward steady pressure on the wrench and turn it clock-wise.
5. When the thread has taken a good start then, turn the tap wrench by both hands giving down-ward equal pressure with both hands.
6. Cut the thread by turning the tap about ¾ of a turn forward and about ¼ of a turn backward.
7. Use plentty of lubricant.

8. Continue the operation untill the length of tap passes through the hole so that it projects a little beyond the surface of work piece.

Note:- If the threads are to be cut in a blind whole, then the sequence of using the taps will be that first use taper tap then second tap and lastly the bottom tap. Procedure of using the other kind of taps, is similar as for using taper tap.

(b) EXTERNAL THREAD CUTTING:-

1. Hold the conduit pipe in the pipe vice
2. File conduit to remove hard scale and chamfer the end for easy entrance into die.
3. Fix the required size of die in the die stock.
4. Now insert the die on the chamfered end of the pipe and make sure that the die stock is at right angle to the axis of pipe.
5. Now hold the die stock with both hands and then turn the die stock in clockwise direction applying equal pressure with both ends.
6. When cutting has actually started, the die should be turned back-ward and forward in a similar way as done while tapping.
7. Use plenty of lubricant.
8. When sufficient length of thread has been made, the stock should be screwed back and adjusting screw is tightened up further, The process is then repeated.
9. For cutting threads of solid rod, the procedure is same as for pipes.
10. When the threads cut, remove the die and try the cut over threads of the nut is too tight, against the die and take another cut.

PRECAUTIONS:-

1. The diameter of the hole should be less than the corresponding size of the tap. For example for a tap size of 25 mm, the hold diameter should be of 21 mm.

2. The tap and the die stock should be held at right angle to the job.

3. Exert equal pressure with both hands.

4. Taps and dies should be turned back ocassionally.

5. It is necessary to use lubricant freely.

6. Do not apply excessive force while using small taps. Excessive pressure may break the tap.

QUESTIONS FOR EVALUATION:-

1. How many types of taps are there in a tap set?

2. For what purpose different types of taps are used?

3. Why the die or tap is turned back occassionally?

4. Why is it necessary to apply equal pressure with both hands?

5. Why the tap and die stock should be held at right angles to the job?

6. Why the size of tap should be more than the drill hole?

7. Why excessive force should not be applied while using small taps ?

EXPERIMENT/PRACTICAL No.10:

TITLE OF EXPERIMENT/PRACTICAL :-

Practice in wooden Sawing, planning and chiseling - Making cross halving joint and Sawing of sunmica and backelite sheets.

SPECIFIC OBJECTIVES :-

To develop the skill in sawing, planning, and chiseling wood.

INTRODUCTORY INFORMATION AND THEORY:

INFORMATION:

Lineman requires in his day to day work to make wooden items for overhead lines like cross arms, cutting of backelite/sunmica sheet for switch board etc. So the knowledge of sawing, planing and chiseling is important for him.

THEORY:-

(a) SAWING:-

Sawing is one of the basic operations carried out in a carpentry shop. A wood is required to be sawen along the grains or across in many shapes such as straight, inclined or curved.

(b) PLANNING:-

It is the operation of truing of a piece of wood by a planer. The success of most pieces of work depends on this basic operation. A properly planned surface should be perfectly straight in all directions, parallel in width, thickness and with edge square to the face.

(c) CHISELING:-

Accurate cutting, fitting and shaping can be done with sharp and correctly beveled wood chisel. The size of the chisel varies from ½" to 2".

EQUIPMENT AND MATERIAL :-

(a) EQUIPMENT:-

1. Tenon Saw
2. Try square
3. Pencil
4. Wooden Bench
5 Firmer chisel
6. Carpenter's mallet.

7. Jack plane
8. 4 folding Box wood rule
9. Marking gauge
10. Hand drill
11 Coping saw.

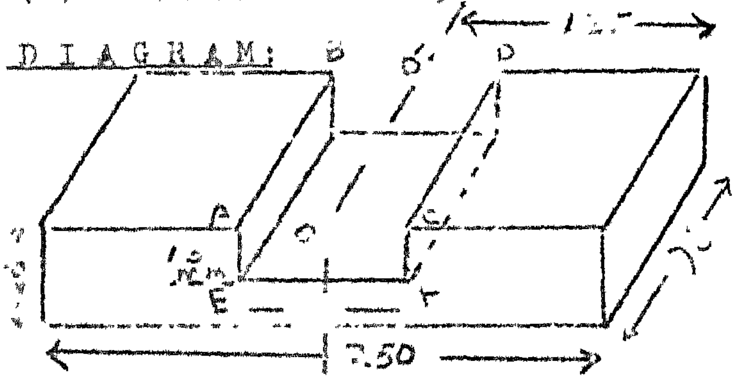
MATERIAL:-

(a) One piece of wood measuring 500 X 100 X 30 mm of sal/Deodar wood.

(b) Sunmica sheet 25 X 100 X 2 mm.

(c) Backelite sheet 250 X 100 X 10 mm.

DIAGRAM:



PROCEDURE:-

(a) SAWING:-

1. Measure the length of 250 mm from one end of the given piece and mark the pencil and try square. Also make a mark on the thickness side.

2. Hold the piece in the vice firmly, making sure that marked point is not projecting too much from the vice.

3. Hold the saw in the right hand with the first finger resting on the handle of saw.

4. To start a cut place the saw at marked point and draw the saw toward yourself a few times, the left hand thumb positioning it to the line.

5. Then saw with easy (short) strokes at an angle of about 45 degree, then test with try square to see that the saw blade is insulting at right angles to the surface.

6. Continue cutting with long strokes at a 45° angle to board.

7. When nearly through, straighten the saw up vertical and cut off the piece supporting it with the left hand.

8. Now we have the two pieces of 250 X 100 X 30 mm dimension. The next operation will be planning.

9. Same procedure is used for cutting a piece of sunmica or backelite from a given sheet.

10. For cutting a slot (rectangular or round) in a thin sunmica or backelite sheet the following procedure is adopted:

    (i) Mark the size of the slot to be cut on the given sheet.

    (ii) Drill a hole inside the line with the help of drill. Size of the hole should be such that the blade of the copying saw can easily pass.

    (iii) Insert the blade in the hole and fix it in the copying saw frame.

    (iv) Now start cutting alongwith the marked line.

(b) PLANNING:-

(SQUARING THE WOODEN PIECE)

1. Place one of the pieces against a wooden rest fitted on the work bench to plane face.

2. Hold the handle of the plane with the right hand, first finger pointing outward and the left hand on the front side of the plane so that the fingers pointing downward.

3. With the left hand press the plane to keep it level with the wood and then push it with the right hand in the forward stroke. Each time the pressure is to be applied in forward strokes and is to be released in backward stroke.

4. As planning proceeds material should be checked with try square to see if it is straight across the face. Also test the surface across diagonals to detect a wind.

5. SQUARING FIRST EDGE:

    Fasten the piece in the vice and then plane the edge. At the beginning of the stroke, apply pressure in the plane with left hand and while at the end of the stroke, apply pressure in the plane with right hand.

6. Test the edge for squareness with try square against the planed surface.

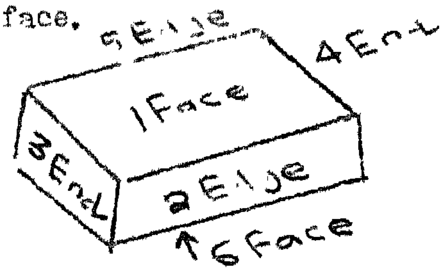
- -

7. SQUARE FIRST END:-

Fasten the board in the vice [illegible] one corner on unfinished edge. Plane the end towards chamfered corner until it is square with the planed surface and edge.

8. Taking already planned surfaces as basic surface, mark the pieces to get the finished pieces of 250 X 96 X 26 mm. size.

9. Similarly plane opposite end, oppsote edge and in the last the final surface.



(c) CHISELING:-

1. Now on one of the finished pieces, mark a centre line oo' (as shown in fig.) at a distance of 125 mm from one end. From this centre line mark two lines AB & CD on either sides at distance of 48 mm. Now on thickness side, mark two lines AE & CF in such a way that EF line is at a distance of 13 mm from AC. Similarly mark the lines upto 13 mm depth on the opposite face.

   Saw down along the lines AB & CD upto the depth of 13 mm.

2. Now make two more saw cuts between A&C at equal distances upto the depth of less than 13 mm.

3. With the flat side of the firmer chisel up, cut from all edges inwards to remove extra material by striking with carpenter's mallet.

4. With flat side down, finish it to the given dimensions.

5. Prepare the second piece in the similary way.

6. Fit the joint together hand tight and level it.

PRECAUTIONS:-

1. For sawing hold the piece firmly in the vice.

2. At the end of cut, support the cutting piece with the left hand.

3. Keep the marking in mind while sawing, planing and chiseling.

4. Use only carpenter's mallet for striking the chisel.

5. Chisel blades should be firmly fixed in the wooden handle.

QUESTIONS FOR EVALUATION :-

1. Why Carpenter's mallet is used while chiseling instead of metal hammer.
2. For rough chiseling which face of the chisel is kept up.
3. For finish chiseling which face of the chisel is used down.
4. What should be the angle of the saw with the jobs while sawing.
5. On which stroke i.e. backward or forward, the saw or plane cuts.
6. At the end of sawing, why the cutting piece is supported left hand.

EXPERIMENT/PRACTICAL No.11

TITLE OF EXPERIMENT/PRACTICAL :-

Scraping, sanding, priming and painting of metal poles and their fitting.

SPECIFIC OBJECTIVES :-

To develop skills in painting a metal pole or metal parts.

INTRODUCTORY INFORMATION AND RELATED THEORY :-

INFORMATION:-

Metal poles and their fittings are required to be protected from injurious effect of atmosphere and other agencies. It also improves the appearance.

RELATED THEORY:-

Bare metal surfaces are subjected to rusting, corrosion due to weather conditions so as to protect the exposed metal surfaces, they should be painted. There are various types of paints required for electric poles such as priming paint, anti corrosion paint, aluminium paint. Old paints can be removed by burning or by applying paint solvant.

EQUIPMENT AND MATERIAL :-

EQUIPMENT:-

Steel brush, sand paper, painting brush, blow lamp, cotton waste, scraper.

MATERIAL:-

Lime or caustic soda, primer, aluminium paint, anti corrosive paint, old painted pipe and new pipe of the same material as that of electric pipe.

PROCEDURE:-

(a) For painting a old pipe/surface

1. First of all remove the old paint by brushing with the help of blow lamp,
2. The loose burnt paint should be removed by scrapper.

COMMON PROCEDURE FOR OLD AND NEW SURFACE :-

1. Before applying a paint the steel surface must be cleaned of all dirt, loose scales, rust, grease or moisture with the help of stiff wire brush and by washing with lime or caustic soda solution and allow it to dry.

2. Apply a coat of primer with the help of painting brush and allow it to dry.
3. Now apply two coats of aluminium paint with flat painter's brush taking care that first coat dries and then only the second coat is to be applied.
4. Now apply anticorrosion paint in the length which is going to be embedded in the ground.
5. Apply the final coat of aluminium paint on the remaining length with the help of brush.

   Same procedure is applicable for painting other fittings/ surfaces.

PRECAUTIONS:-

1. While using caustic soda solution for cleaning take care that it does not spill over your body.

QUESTIONS FOR EVALUATION:

1. Why the old paint is removed before applying paint?
2. Why the surfaces are required to be painted?
3. Why the surfaces are required to be cleaned before painting?
4. How will you remove the grease from the surface?
5. Why primer is used?
6. Why aluminium paint is suitable for electric poles?
7. What is the purpose of anti corrosive paint?

EXPERIMENT/PRACTICAL No.12:

TITLE OF EXPERIMENT/PRACTICAL:-

Treatment and painting of wooden poles

SPECIFIC OBJECTIVES:-

To acquire skill of painting a wooden pole.

INTRODUCTORY INFORMATION AND RELATED THEORY:

INFORMATION:-

Wooden poles are used for L.T. (low tension) distribution mostly in hilly areas. The wood is liable to decay due to affect of weather conditions and white ants etc. Hence the wooden poles are required to be protected against decay.

RELATED THEORY:-

Bare wooden surfaces are affected by weather conditions and attacked by white ants and their life is reduced. To protect wooden surfaces it should be painted. The portion of wooden pole which is embedded inside the ground is required to be protected against white ants etc. This portion is treated by charring which avoid the attack of white ants. Charring consists of burning the pole upto a depth of 12 mm. over fire and then quenching in water.

EQUIPMENT AND MATERIAL:-

EQUIPMENT:-

1. Sand paper,
2. Painting brush,
3. Cotton waste,
4. Fire wood,
5. Match box,
6. Water tub.

MATERIAL:-

1. A piece of wooden pole
2. Solvent for removing paint
3. Lime or caustic soda
4. Red lead ground with strong glue size in water.
5. Primer
6. Paint

PROCEDURE:-

1. Before applying paint, the pole should be carefully cleaned and rendered smooth by sand paper and cotton waste. In case surface is greasy, wash the surface with caustic soda solution.

2. If there are any knots, a hot coat of red-lead ground with strong glue size in water is applied and is allow to dry.

3. After the above is done, apply a coat of red lead ground in boiled linseed oil and thinned with turpentine.

4. After knoting, a primer coat is applied and should be allowed to dry.

5. After priming, apply two or three coats of paint as required making sure that previous coat is thoroughly dried before succeeding coat is applied.

6. The portion of the pole which is embedded in the ground, it must be charred by burning over a wood fire to a depth of 12mm. and then quenched in water.

PRECAUTIONS:-

1. While using caustic soda solution for cleaning, care should be taken that it does not spill over the body.

QUESTIONS FOR EVALUATION:-

1. Why the wooden surfaces are required to be painted?
2. Why the old paint is removed before applying the new paint?
3. Why the surfaces are required to be cleaned before painting?
4. How will you remove grease from the surface?
5. Why primer is used?
6. What is charring and why it is done?
7. What is knot? Why knots are required to be treated?

APPENDIX - I

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APPENDIX - II

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APPENDIX - III

Questionnarie for Collecting Opinion of
Teachers and Students
On the
Instructional-cum-Practical Manual
On
BASIC MATERIAL AND RELATED WORKSHOP

for

Lineman Vocation Class - XI

(Experimental Edition)

1 9 8 4

DEPARTMENT OF VOCATIONALIZATION OF EDUCATION

NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

SRI AUROBINDO MARG , NEW DELHI -110016.

Dear Teacher/Student,

We are happy to place this Manual at your disposal with the hope that it will help you to conduct the practical works prescribed in the syllabi and to gain required competencies through vocational expertise.

the This Manual conforms to / syllabi of Lineman Vocation Class-XI offered by the State of Haryana and includes most of the important activities to be performed by a Lineman. This is an experimental edition with ample scope for further improvement through feed back from you. We solicit your active co-operation for the improvement of the Manual.

After having used this Manual for a year or more, kindly read the appended questionarie carefully and write down the answers precisely and exactly to the point. You may use additional sheets of paper, if the space provided is insufficient. The questionnarie may be mailed at the following address :

Shri Sachchidananda Ray
Programme Co-ordinator
Deptt. of Vocationalisation of Educ
National Council of Educational
Research & Training
Sri Aurobindo Marg
NEW DELHI -110016.

QUESTIONNAIRE FOR THE TEACHERS

LABORATORY MANUAL ON ______________________________

A. Name of the Teacher
(In Block Letters) ______________________________

B. Name and Postal address
of the Institution ______________________________

____

____

C. i) Qualification ______________________________

ii) Teaching Experience ______________________________

iii) Professional/Field/Industrial
experience ______________________________

1. Do the experimental activities covered in the Manual develop desired skills in the students ?

Yes/No

2. List the experimental activities included in the Manual which do not figure in the syllabus ?

3. List the experimental activities included in the Manual which do not figure in the syllabus, but are vocationally important.

4. List the experimental activities prescribed in the syllabus but not covered in the Manual.

5. List the vocationally important experimental activities which are neither included in the Manual nor prescribed in the syllabus.

6. a) Does the relevant information given under every experimental activitiey furnish enough theoretical back ground of the activity.

Yes/No

b) If not, list the experiments where relevant informatio needs further modification.

Experiment No	Portion	Type of modification needed

7. a) Does the relevant information contain any factual errors or inaccuracies ?

Yes/No

b) If any, give details

Experiment No	Error/Inaccuracy	Should read as

8. Did you come across any expressions/sentences in the Manual which do not carry precise meaning or information ? If Yes, then give the details.

Page No.	Expression/Sentence	Would be more appropriate

9. Are the instructional objectives pertaining to each experimental activity rational ? If not, list down the irrational, irrelevant or vague ones.

Experiment No.	Irrational/Vague Objectives

10. Does accomplishment of the experiments result in realisation of the objectives.

Yes/No

11. Could you suggest any improvement in the presentation of the experiments along with your observations ?

Experiment No	Observations

12. Are the illustrations adequate ?

Yes/No

13. Are there any inaccuracies in the illustrations/ diagrammes given in the manual ? If yes please point them out.

Illustration No	Discrepancy/Inaccuracy

14. Please give your over all opinion about the Manual which may be useful in the effective improvement of the future editions.

QUESTIONNAIRE FOR THE STUDENTS.

LABORATORY MANUAL OF ______________________________

A. Name of the Student (In Block letters) ______________________________

B. Name and address of the school/college ______________________________

____

C. Class ______________________________

D. Medium of Instruction ______________________________

1. List out the portions of the manual which you found difficult to understand and give reasons.

Experiment No	Portions of the Text	Difficulty experienced

2. Mention the places where you found the language difficult to understand

Experiment No	Page No	Difficulty experienced

3. Point out the figures/illustrations which do not help in understanding the topic/theme.

Illustration No	Your observations/Difficulty experienced

4. Can you conduct the experiments your self with the help of this manual ?

Yes/No

If not, point out the portions of activity units which need further elaboration or explanation.

Experiment No	Portion to be elaborated

5. Was the theoretical portion given in the Manual useful to you in understanding the why of the experiment ?

Yes/No.

6. Do you now understand the scientific reasons behind the steps you have taken in conducting various experiments ?

7. Yours overall opinion about the Manual.